jc685 U.S. PTO
09/12/00

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	8733.298.00
First Inventor or Application Identifier	Dong Yeung KWAK
Title	TFT LCD

09/660186 U.S. PTO 09/12/00

APPLICATION ELEMENTS
See MPEP chapter 600 concerning utility patent application contents

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. ☒ Fee Transmittal Form (e.g. PTO/SB/17) (Submit an original and a duplicate for fee processing)
2. ☒ Specification — Total Pages: 12
3. ☒ Drawing(s) *(35 U.S.C. 113)* — Total Sheets: 3
4. ☒ Oath or Declaration — Total Pages: 2
   a. ☒ Newly executed (original or copy)
   b. ☐ Copy from a prior application *(37 C.F.R. §1.63(d))* *(for continuation/divisional with box 15 completed)*
      i. ☐ DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see *37 C.F.R. §1.63(d)(2) and 1.33(b)*
5. ☐ Incorporation By Reference *(usable if box 4B is checked)* The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4B, is considered to be part of the disclosure of the accompanying application and is hereby incorporated by reference therein

ACCOMPANYING APPLICATION PARTS

6. ☒ Assignment Papers (cover sheet & document(s))
7. ☐ 37 C.F.R. §3.73(b) Statement *(when there is an assignee)* ☐ Power of Attorney
8. ☐ English Translation Document *(if applicable)*
9. ☐ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations
10. ☐ Preliminary Amendment
11. ☒ White Advance Serial No. Postcard
12. ☐ Small Entity Statement(s) ☐ Statement filed in prior application. Status still proper and desired.
13. ☒ Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
14. ☒ Other: Check in the amount of $690.00
    Request for Priority

15. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below.*
    ☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application no.:
    Prior application information: Examiner: Group Art Unit:

16. Amend the specification by inserting before the first line the sentence:
    ☐ This application is a ☐ Continuation ☐ Division ☐ Continuation-in-part (CIP) of application Serial No. Filed on
    ☐ This application claims priority of provisional application Serial No. Filed

17. CORRESPONDENCE ADDRESS

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Docket No. 8733.298.00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

INVENTOR(S) Dong Yeung KWAK
SERIAL NO: To Be Assigned
FILING DATE: September 12, 2000
FOR: TFT LCD

FEE TRANSMITTAL

ASSISTANT COMMISSIONER FOR PATENTS
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FOR	NUMBER FILED	NUMBER EXTRA	RATE	CALCULATIONS
TOTAL CLAIMS	20 - 20 =	0	× $18 =	$0.00
INDEPENDENT CLAIMS	3 - 3 =	0	× $78 =	$0.00
☐ MULTIPLE DEPENDENT CLAIMS (If applicable)			+ $260 =	$0.00
☐ LATE FILING OF DECLARATION			+ $130 =	$0.00
			BASIC FEE	$690.00
			TOTAL OF ABOVE CALCULATIONS	$690.00
☐ REDUCTION BY 50% FOR FILING BY SMALL ENTITY				$0.00
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Respectfully Submitted,

LONG ALDRIDGE & NORMAN LLP

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UNITED STATES PATENT APPLICATION

OF

DONG YEUNG KWAK

FOR

TFT LCD

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a liquid crystal display, and more particularly, to a TFT(Thin Film Transistor) LCD(Liquid Crystal Display) having a large aperture.

Background of the Related Art

Referring to FIG. 1A, an AMLCD(Active Matrix Liquid Crystal Display) used in a portable TV or a notebook computer, or the like is provided with a plurality of scanning lines 10 and signal lines 17 crossing each other, and pixel regions defined by the scanning lines 10 and the signal lines 17. There are TFTs at parts the scanning lines 10 and the signal lines are crossed, and pixel electrodes(dashed lines in the drawing) in the pixel regions, for displaying a desired picture when a voltage is applied to the scanning lines 10, to switch the TFT, to transmit a picture signal provided to the signal lines 17 to the pixel electrodes.

Referring to FIG. 1B showing a section across line A-A', the AMLCD is provided with a gate electrode 11 on a transparent substrate 7, and a gate insulating layer 13 on the gate electrode 11. There is a channel layer 15 and an ohmic contact layer 16 of amorphous silicon a-Si on the gate insulating layer 13, and source/drain electrodes 17a and 17b on the ohmic contact layer 16. There is a protection layer 19 on an entire surface of the source/drain electrodes 17a and 17b, a contact hole 20 in the protection layer 19. The pixel electrode 21 and the drain electrode 17b are connected through the contact hole 20. In the drawing, Cgs denotes a capacitance between the gate electrode and the source electrode, Cgd denotes a capacitance between the gate electrode and the drain electrode. The Ccross denotes a capacitance in overlap regions of the scanning lines and the signal lines. The Cgs, Cgd, and Ccross are parameters influencing to an accumulated capacitance(not shown), as well as ΔVp and $\Delta Vpxl$. In the related

art LCD, if there is a misalign between the scanning line 10 and the signal line 17, minute variations of Cgs and Cgd give influence to ΔVp and $\Delta Vpxl$, making flicker worse and causing non-uniform luminance, that deteriorates a picture quality. And, in a divided exposure for a large sized screen, the increased deviations of Cgs and Cgd caused by poor adjustment between shots worsens the foregoing problem, to impede providing a large sized LCD screen, and, since the TFT is formed on an extension line of the scanning line, to reduce an aperture of the device.

SUMMARY OF THE INVENTION

Accordingly, the present invention is directed to a TFT LCD that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

An object of the present invention is to provide a TFT LCD in which an effective voltage to liquid crystal is stabilized, for making a stable operation.

Another object of the present invention is to provide TFT LCD which can maintain a fixed capacitance between a scanning line and a drain electrode even if the scanning line and the signal line are misaligned.

Other object of the present invention is to provide TFT LCD which shows no deterioration of a picture quality even in divided exposure for a large sized screen.

Further object of the present invention is to provide TFT LCD which has an improved aperture ratio.

Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, the TFT LCD includes a first substrate and a second substrate, a scanning line on the first substrate, a signal line formed to cross the scanning line, a channel layer formed along the signal line and extended to a portion of the scanning line, source and drain electrodes formed separated on the channel layer over the scanning line, a pixel electrode connected to the drain electrode, and a liquid crystal layer formed between the first substrate and the second substrate.

The channel layer has a width smaller than a width of the scanning line and the signal line overlapped between the scanning line and the signal line.

The signal line, also serving as a source electrode of a TFT, requires no extension line of the related art signal line, and can maintain a capacitance Cgd between the scanning line and the drain electrode always constant even if there is misalignment between the scanning line and the signal line because a pattern extended from the drain electrode overlaps the scanning line fully.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention:

In the drawings:

FIG. 1A illustrates a plan view of a unit pixel of a related art LCD;

FIG. 1B illustrates a section across line A-A' in FIG. 1A;

FIG. 2A illustrates a plan view of a unit pixel of an LCD in accordance with a preferred embodiment of the present invention;

FIG. 2B illustrates a section across line B-B' in FIG. 2A; and,

FIG. 3 illustrates a plan view of a unit pixel of an LCD in accordance with another preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. FIG. 2A illustrates a plan view of a unit pixel of an LCD in accordance with a preferred embodiment of the present invention, and FIG. 2B illustrates a section across line B-B' in FIG. 2A.

Referring to FIG. 2B, the LCD in accordance with a preferred embodiment of the present invention includes a scanning line(a gate electrode) 111 of a metal, such as aluminum, formed on a transparent substrate 107 by sputtering. There is an insulating layer 113 of SiNx or SiOx or the like formed thereon by APCVD(Atmospheric Chemical Vapor Deposition), and a semiconductor layer 115 and an n^+ layer 116 stacked in succession thereon. The semiconductor layer 115 is formed of amorphous silicon a-Si, and the n^+ layer 116 is formed of SiO_2 having good bulk characteristics, and can prevent short circuit of the gate electrode 111 and formation of hillock at the gate electrode 11 without an anodized film. There are a channel layer and an ohmic contact layer 116 formed by etching the semiconductor layer 115 and the n^+ layer 116, and source/drain electrodes 117a and 117b of aluminum or chrome formed by sputtering and patterning. The ohmic contact layer 116 is formed by dry etching by using the source/drain electrodes 117a and 117b as a mask. There is a protection layer 119 of SiNx on an entire surface

of the substrate 107 formed by PECVD(Plasma Enhanced Chemical Vapor Deposition), and a pixel electrode 121 thereon in a pixel region formed by sputtering and patterning ITO(Indium Tin Oxide). The pixel electrode 121 is connected to the drain electrode 117b electrically through a contact hole 120 in the protection layer 119. The channel layer 115 has a width smaller than the same of the scanning line 111 and the signal line 117a, and positioned between the scanning line 111 and the signal line 117a. In this instance, since the channel layer 115 is covered with the signal line 117a, generation of off-current is prevented, to prevent deterioration of a picture quality caused by a residual image. The signal line 117a, serving as a source electrode of the TFT also, requires no extension pattern of the signal line as in the related art, and maintains a capacitance Ccross formed in an overlap region of the scanning line 111 and the signal line 117a constant. And, the signal line 117a maintains a capacitance Cgs between the scanning line 111 and the signal line 117a constant even if a misalignment is occurred between the scanning line 111 and the signal line 117a. Since a pattern extended from the drain electrode 117b overlaps the scanning line 111 completely, even if there is a misalignment between the scanning line 111 and the signal line 117a, the capacitance between the scanning line 111 and the drain line 117b is maintained constant always. Accordingly, the ΔVp and $\Delta Vpxl$ involved in the effective voltage for driving the LCD are maintained constant owing to the Cgs, Cgd, and Ccross, which are always constant regardless of the misalignment. In the drawing, 'δ' is greater than a movement caused by the misalignment of the scanning line 111 and the signal line 117a, 'Δ' is greater than a movement caused by the misalignment of the scanning line 111 and the channel layer 115, and 'α' is greater than a movement caused by the misalignment of the signal line 117a and the channel layer 115.

FIG. 3 illustrates a plan view of a unit pixel of an LCD in accordance with another

preferred embodiment of the present invention, wherein reference symbols are the same as the foregoing embodiment, and operation of the present embodiment is also the same. This embodiment is different from the previous embodiment in that a portion for the channel layer is extended by 'β' to increase a width 'w' of the channel layer on the scanning line, which is wider than a variation of the Cgd caused by the misalignment, to assure a more stable operation of the LCD. As shown in FIG. 3, it is possible that the width can be increased by 'β'' instead of 'β' (dashed portion), or by both the 'β'' and 'β'.

As explained, the TFT LCD of the present invention has the following advantages.

The TFT LCD of the present invention can provide an LCD which can make a stable operation by maintaining both a capacitance Ccross formed in an overlap region of the scanning line and the signal line and the capacitance Cgs between the scanning line and the source electrode always constant, and by maintaining a capacitance Cgd between the scanning line and the drain electrode always constant by overlapping a pattern extended from the drain electrode with the scanning line completely.

And, the TFT LCD of the present invention is favorable for fabrication of a large sized LCD as a picture quality can be made uniform even in a case of a divided exposure, can improve an aperture ratio of the device because the TFT is formed on the scanning line.

It will be apparent to those skilled in the art that various modifications and variations can be made in the TFT LCD of the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is Claimed is:

1. A TFT LCD(thin film transistor liquid crystal display) comprising:

a first substrate and a second substrate;

a scanning line on the first substrate;

a signal line formed to cross the scanning line;

a channel layer formed along the signal line and extended to a portion of the scanning line;

source and drain electrodes formed separated on the channel layer over the scanning line;

a pixel electrode connected to the drain electrode; and,

a liquid crystal layer formed between the first substrate and the second substrate.

2. A TFT LCD as claimed in claim 1, wherein the drain electrode is parallel to the signal line.

3. A TFT LCD as claimed in claim 1, wherein the channel layer has a width smaller than a width of the signal line and the scanning line.

4. A TFT LCD as claimed in claim 1, further comprising a gate insulating layer between the scanning line and the channel layer.

5. A TFT LCD as claimed in claim 1, further comprising an ohmic contact layer between the source and drain electrodes and the channel layer.

6. A TFT LCD as claimed in claim 1, wherein the source electrode and the signal line are formed as a unit.

7. A TFT LCD as claimed in claim 1, wherein the drain electrode is overlapped with the scanning line.

8. A TFT LCD comprising:

a first substrate and a second substrate;

a plurality of scanning lines on the first substrate;

a gate insulating layer on an entire surface inclusive of the scanning line;

a channel layer on the gate insulating layer to cross the scanning lines having a portion extended to a top of the scanning lines;

source and drain electrodes formed separated on the channel layer over the scanning line;

a signal line formed as a unit with the source electrode along the channel layer which is formed to cross the scanning lines;

a protection film formed on an entire surface inclusive of the signal line;

a pixel electrode connected to the drain electrode on the protection film; and,

a liquid crystal layer formed between the first substrate and the second substrate.

9. A TFT LCD as claimed in claim 8, wherein the drain electrode is parallel to the signal line.

10. A TFT LCD as claimed in claim 8, wherein the drain electrode crosses the scanning

line.

11. A TFT LCD as claimed in claim 8, wherein the channel layer has a width smaller than a width of the signal line and the scanning line.

12. A TFT LCD as claimed in claim 8, further comprising an ohmic contact layer between the source and drain electrodes and the channel layer.

13. A TFT LCD as claimed in claim 8, wherein the scanning line has a portion enlarged in the vicinity of the signal line.

14. A TFT LCD as claimed in claim 13, wherein the channel layer is formed along the signal line over the scanning line, and has a width enlarged as much as a width of the scanning line is enlarged.

15. A TFT LCD having a first substrate, a second substrate, and liquid crystal sealed between the first and second substrates, comprising:

a scanning line on the first substrate;

a gate insulating layer on the scanning line;

a channel layer on the gate insulating layer;

a signal line formed to cross the scanning line to cover a portion of the channel layer;

a drain electrode formed on the channel layer spaced a distance away from the signal line in parallel to the signal line;

a protection film formed on an entire surface of the first substrate inclusive of the drain electrode; and

a pixel electrode formed on the protection film connected to the drain electrode.

16. A TFT LCD as claimed in claim 15, wherein the channel layer is formed along the signal line.

17. A TFT LCD as claimed in claim 16, wherein the channel layer has a width smaller than a width of the signal line and the scanning line.

18. A TFT LCD as claimed in claim 15, wherein the signal line serves as a source electrode disposed opposite to the drain electrode.

19. A TFT LCD as claimed in claim 15, further comprising a gate insulating layer between the scanning line and the channel layer.

20. A TFT LCD as claimed in claim 18, further comprising an ohmic contact layer between the source and drain electrodes and the channel layer.

ABSTRACT

TFT LCD including a first substrate and a second substrate, a scanning line on the first substrate, a signal line formed to cross the scanning line, a channel layer formed along the signal line and extended to a portion of the scanning line, source and drain electrodes formed separated on the channel layer over the scanning line, a pixel electrode connected to the drain electrode, and a liquid crystal layer formed between the first substrate and the second substrate.

FIG. 1A
Related Art

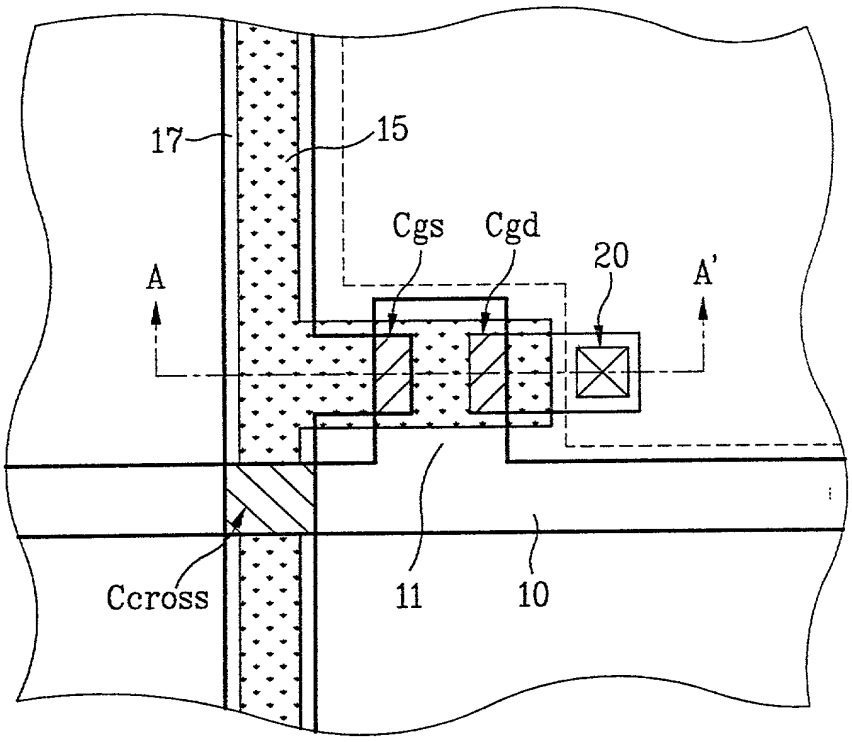


FIG. 1B
Related Art

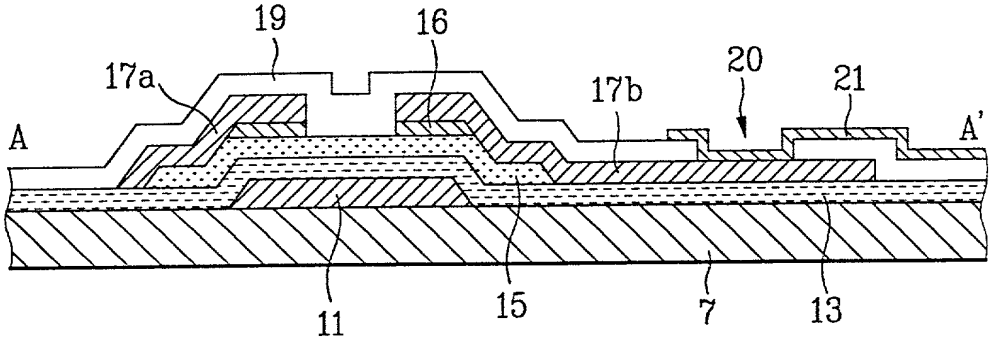


FIG. 2A

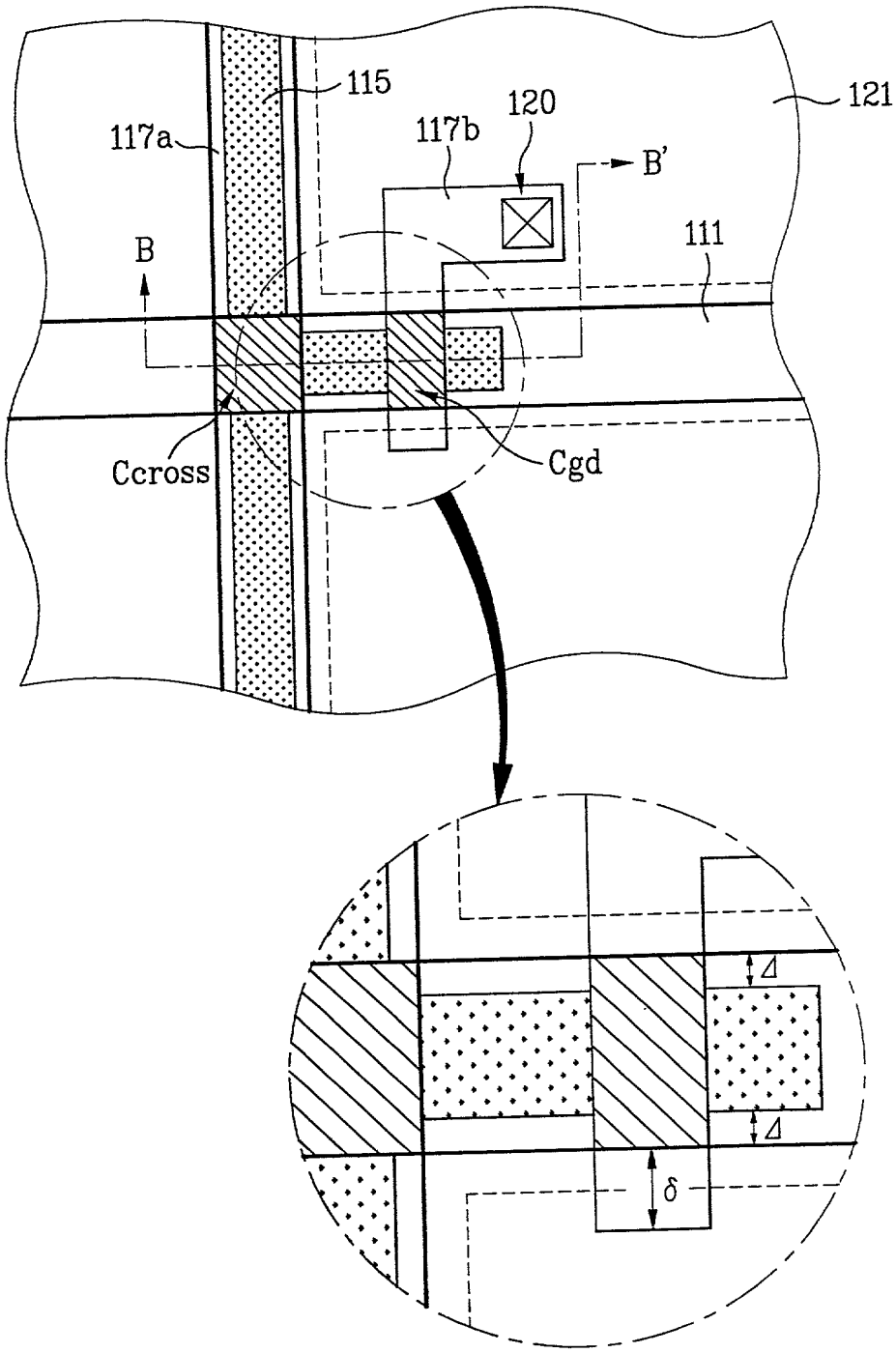


FIG. 2B

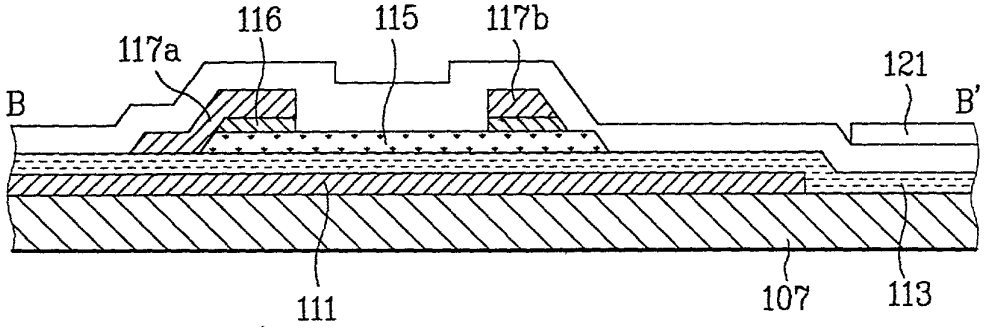
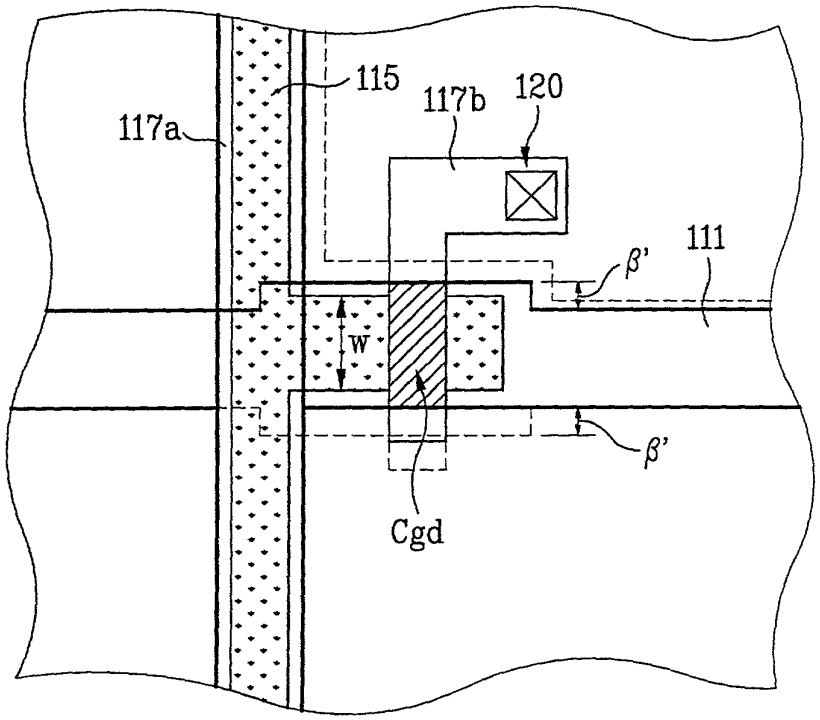

116
115
117b
117a
121
B
B'
111
107
113

FIG. 3


115
117b
120
117a
111
β'
W
β'
Cgd

Docket No.:

Declaration, Power of Attorney and Petition

WE (I) the undersigned inventor(s), hereby declare(s) that:

My residence, post office address and citizenship are as stated below next to my name,

We (I) believe that we are (I am) the original, first, and joint (sole) inventor(s) of the subject matter which is claimed and for which a patent is sought on the invention entitled

TFT LCD

the specification of which

- ☐ is attached hereto.
- ☐ was filed on _____
  as Application Serial No. _____
  and amended on _____
- ☐ was filed as PCT international application
  Number _____
  on _____
  and was amended under PCT Article 19
  on _____ (if applicable).

We (I) hereby state that we (I) have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

We (I) acknowledge the duty to disclose information known to be material to the patentability of this application as defined in Section 1.56 of Title 37 Code of Federal Regulations.

We (I) hereby claim foreign priority benefits under 35 U.S.C. §119(a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed. Prior Foreign Application(s)

Application No.	Country	Day/Month/Year	Priority Claimed
1999-39290	Korea	14 / September / 1999	■ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No

We (I) hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below.

(Application Number)	(Filing Date)
(Application Number)	(Filing Date)

We (I) hereby claim the benefit under 35 U.S.C. §120 of any United States application(s), or §365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

Application Serial No.	Filing Date	Status (pending, patented, abandoned)

And we (I) hereby appoint Song K. Jung, Reg. No. 35,210; Sharon E. Crane, Ph.D., Reg. No. 36,113 and Kenneth D. Springer, Reg. No. 39,843 and as our (my) attorneys, with full powers of substitution and revocation, to prosecute this application and to transact all business in the Patent Office connected therewith; and we (I) hereby request that all correspondence regarding this application be sent to Song K. Jung of Long Aldridge & Norman LLP, Attorneys At Law, 6th Floor, 701 Pennsylvania Avenue, N.W., Washington, D.C. 20004.

We (I) declare that all statements made herein of our (my) own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Dong Yeung KWAK
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Signature of Inventor

09 / 04 / 2000
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